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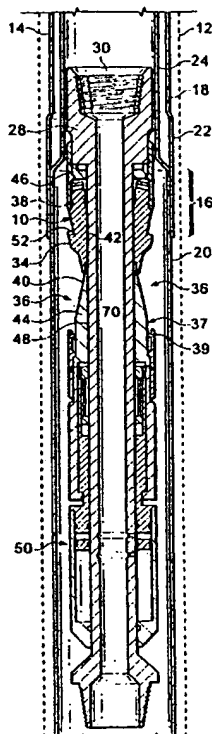
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(54) Title: **CUTTER FOR WELLBORE CASING**

(57) Abstract: A cutter (10) for a wellbore casing (20) is provided that includes a rotatable tubular support (28), at least one cutter blade (34) supported on the rotatable tubular support, having a retracted position for insertion into the wellbore casing and having an expanded position for cutting engagement with the wellbore casing, and an actuator (50) for moving the cutter blade from the retracted position to the expanded position for cutting engagement with the wellbore casing.



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Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,150,755 A (Cassel et al ) 29 September 1992, Figs 2-4, col. 4, line 19-col. 6, line 41.	1, 2, 10, 12-14, 16, 17
X	US 4,938,291 A (Lynde et al.), 3 July 1990, Figs 1, 2, col. 4, line 41-col. 5, line 42.	1, 2, 10, 12-14, 16, 17
X	US 5,242,017 A (Hailey) 7 September 1993, Fig. 1, col 2, line 55-col. 3, line 28.	1, 2, 10, 12-14, 16, 17
X,E	US 6,679,328 B2 (Davis et al) 20 January 2004, Figs 1, 2, 5, 8, 9, col. 3, line 33-col. 7, line 5.	1-18

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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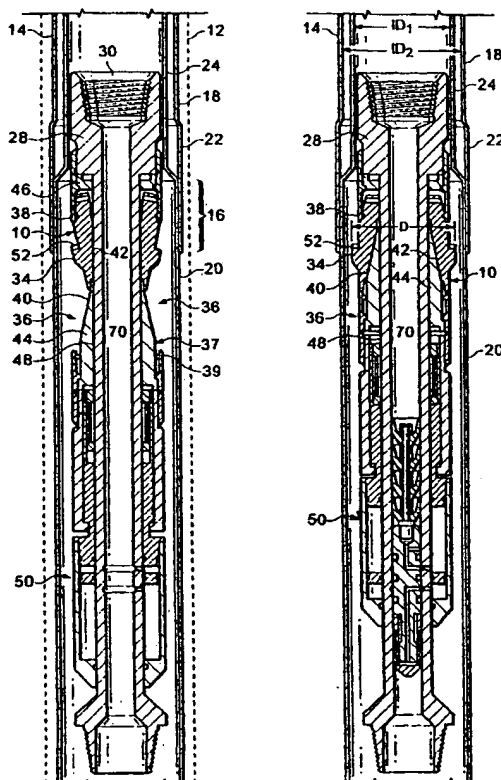
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[Continued on next page]

(54) Title: **CUTTER FOR WELLBORE CASING**



(57) Abstract: A cutter (10) for a wellbore casing (20) is provided that includes a rotatable tubular support (28), at least one cutter blade (34) supported on the rotatable tubular support, having a retracted position for insertion into the wellbore casing and having an expanded position for cutting engagement with the wellbore casing, and an actuator (50) for moving the cutter blade from the retracted position to the expanded position for cutting engagement with the wellbore casing.

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

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**AMENDED CLAIMS**

[received by the International Bureau on 25 August 2004 (25.08.04);  
original claims 11-12, 17-18 amended; claims 19-43 added  
remaining claims unchanged (8 pages)]

position to the expanded position further comprises means for selectively activating the actuator to move the cutter blades from the retracted position to the expanded position for cutting engagement with the wellbore casing and from the expanded position to the retracted position.

8. The cutter tool of claim 7, wherein the actuator comprises a hydraulic cylinder attached to the tubular support and coupled to the expander device, the hydraulic cylinder having an opening chamber for moving the cone in an axial direction for expanding the cutter blades and having a closing cylinder for moving the expander cone in an opposite axial direction for retracting the cutter blade and wherein the activation device comprises a first activation dart seatable in the tubular support for directing fluidic material into the opening chamber of the hydraulic cylinder and a second activation dart seatable in the tubular support for directing fluidic material into the closing chamber of the hydraulic cylinder.

9. The cutter tool of claim 4, wherein the expander cone has a plurality of first cam arms each providing one of the plurality of ramp surfaces and slidingly engaged with a separate one of the plurality of cutter blades and further comprising a second cone having a plurality of cam second arms each having a second ramp surface and interleaved with the first cam arms and a plurality of dummy blades interleaved with the plurality of cutter blades and in sliding engagement with the second ramp surfaces provided on the second cam arms, the dummy blades expandable and retractable with the cutter blades and having insufficient thickness to contact the wellbore casing when expanded.

10. The cutter tool of claim 1, wherein the cutter blade further comprises a cutting tip secured to the cutter blade projecting radially outward when the cutter blade is in the expanded position for cutting engagement between the cutting tip and the wellbore casing.

11. A casing cutting tool, comprising:

an upper tubular support member;

an upper cam assembly comprising:

a tubular base; and

a plurality of cam arms extending from the tubular base in a downward longitudinal direction, each cam arm defining an inclined surface;

a plurality of upper cutting segments interleaved with the cam arms of the upper cam assembly and pivotally coupled to the upper tubular support member;

a lower tubular support member;

a lower cam assembly comprising:

a tubular base; and

a plurality of cam arms extending from the tubular base in an upward longitudinal

direction, each cam arm defining an inclined surface that mates with the inclined surface of a corresponding one of the upper cutter blade segments; wherein the cam arms of the upper cam assembly are interleaved with and overlap the cam arms of the lower cam assembly; and a plurality of lower non-cutting segments interleaved with cam arms of the lower cam assembly and the upper cutting segments, each lower non-cutting segment pivotally coupled to the lower tubular support member and mating with the inclined surface of a corresponding one of the cam arms of the upper cam assembly.

12. (Amended) A method for cutting a wellbore casing comprising :
  - providing a plurality of cutter blades supported on a rotatable tubular support;
  - placing the plurality of cutter blades in a retracted position;
  - inserting the tubular support into the wellbore casing with the cutter blades supported in the retracted position;
  - actuating the cutter blades in the wellbore to expand into a cutting position to engage with the wellbore casing; and
  - rotating the tubular support with the cutter blades supported thereon so that the wellbore casing is cut by the rotating cutter blades.
13. A method of radially expanding cutter blades for cutting a wellbore casing in a wellbore, comprising:
  - supporting the expandable tubular member using a tubular support member and an expandable cutter tool;
  - injecting a fluidic material into the tubular support member;
  - actuating the expandable cutter tool radially outwardly relative to the wellbore casing and into cutting engagement with the wellbore casing using the injected fluidic material.
14. The method of claim 13, further comprising:
  - rotating the expandable cutter tool in cutting engagement with the wellbore casing when the expandable cutter tool is expanded radially outwardly relative to the wellbore casing.
15. The method of claim 14, further comprising:
  - continuing to rotate the expandable cutter tool in cutting engagement with the wellbore casing until an upper portion of the wellbore casing is severed from the wellbore

casing;  
maintaining the expandable cutter tool in the radially expanded position after the  
upper portion of the wellbore casing is severed; and  
raising the expandable cutter tool with the severed casing portion supported  
thereon out of the wellbore.

16. The method of claim 13, wherein actuating the expandable cutter tool radially outwardly relative to the wellbore casing and into cutting engagement with the wellbore casing using the injected fluidic material, further comprises:

directing the fluidic material from within a portion of the tubular support member to an actuator cylinder to cause the cutting tool to slide axially on ramp surfaces so that cutting blades are moved radially outwardly.

17. The method of claim 13, wherein actuating the expandable cutter tool radially outwardly relative to the wellbore casing and into cutting engagement with the wellbore casing, wherein the tubular support member comprises:

an upper tubular support member and a lower tubular support member; and  
wherein actuating the expandable cutter tool comprises displacing the upper tubular support member relative to the lower tubular support member.

18. The method of claim 17, wherein the expandable cutting tool comprises:

an upper cam assembly comprising:

a tubular base; and

a plurality of cam arms extending from the tubular base in a downward longitudinal direction, each cam arm defining an inclined surface;

a plurality of upper cutting blade segments interleaved with the cam arms of the upper cam assembly and pivotally coupled to the upper tubular support member;

a lower cam assembly comprising:

a tubular base; and

a plurality of cam arms extending from the tubular base in an upward longitudinal direction, each cam arm defining an inclined surface that mates with the inclined surface of a corresponding one of the upper cutter blade segments;

wherein the cam arms of the upper cam assembly are interleaved with and overlap the cam arms of the lower cam assembly; and

a plurality of lower dummy segments interleaved with cam arms of the lower cam



assembly and the upper cutting blade segments, each lower dummy segment pivotally coupled to the lower tubular support member and mating with the inclined surface of a corresponding one of the cam arms of the upper cam assembly.

19. A cutter tool for a tubular member, comprising:

a rotatable tubular support;

at least one cutter blade supported on the rotatable tubular support, having a retracted position for insertion into the tubular member and having an expanded position for cutting engagement with the tubular member; and

an actuator means for moving the cutter blade from the retracted position to the expanded position for cutting engagement with the tubular member.

20. The cutter tool of claim 19, further comprising an expander device means coupled to the actuator means for displacing the cutter blade outwardly; and wherein the cutter blade is pivotally mounted on the expander device means.

21. The cutter tool of claim 20, wherein the cutter blade includes an interior sliding surface and the expander device means includes a ramp surface moveable by the actuator means along the tubular support in sliding engagement with the interior sliding surface of the cutter blade to pivot the cutter blade between the retracted position and the expanded position.

22. The cutter tool of claim 21, wherein the at least one cutter blade includes a plurality of cutter blades each pivotally mounted on the expander device means and each having an interior sliding surface and wherein the expander device means comprises an expander cone means supported on a mandrel portion of the tubular support and having a plurality of ramp surfaces slidably engaged with each interior sliding surface of the plurality of cutter blades.

23. The cutter tool of claim 22, wherein the actuator means for moving the cutter device from the retracted position to the expanded position further comprises an activation device means for selectively activating the actuator means to move the cutter blade from the retracted position to the expanded position for cutting engagement with the tubular member.

24. The cutter tool of claim 23, wherein the actuator means comprises a hydraulic cylinder attached to the tubular support and coupled to the expander device means and wherein the activation device means comprises an activation means in the tubular support for directing fluidic material into the hydraulic

cylinder to cause relative sliding movement of the expander cone on the mandrel portion of the tubular support.

25. The cutter tool of claim 22, wherein the actuator means for moving the cutter device from the retracted position to the expanded position further comprises means for selectively activating the actuator to move the cutter blades from the retracted position to the expanded position for cutting engagement with the tubular member and from the expanded position to the retracted position.

26. The cutter tool of claim 25, wherein the actuator means comprises a hydraulic cylinder attached to the tubular support and coupled to the expander device means, the hydraulic cylinder having an opening chamber for moving the cone in an axial direction for expanding the cutter blades and having a closing cylinder for moving the expander cone in an opposite axial direction for retracting the cutter blade and wherein the activation device means comprises a first activation means seatable in the tubular support for directing fluidic material into the opening chamber of the hydraulic cylinder and a second activation means seatable in the tubular support for directing fluidic material into the closing chamber of the hydraulic cylinder.

27. The cutter tool of claim 22, wherein the expander cone has a plurality of first cam arms each providing one of the plurality of ramp surfaces and slidingly engaged with a separate one of the plurality of cutter blades and further comprising a second cone having a plurality of cam second arms each having a second ramp surface and interleaved with the first cam arms and a plurality of dummy blades interleaved with the plurality of cutter blades and in sliding engagement with the second ramp surfaces provided on the second cam arms, the dummy blades expandable and retractable with the cutter blades and having insufficient thickness to contact the tubular member when expanded.

28. The cutter tool of claim 19, wherein the cutter blade further comprises a cutting tip secured to the cutter blade projecting radially outward when the cutter blade is in the expanded position for cutting engagement between the cutting tip and the tubular member.

29. A system for cutting a tubular member comprising :

means for providing a plurality of cutter blades supported on a rotatable tubular support;

means for placing the plurality of cutter blades in a retracted position;

means for inserting the tubular support into the tubular member with the cutter blades supported in the retracted position;

means for actuating the cutter blades in the tubular member to expand into a cutting position to engage with the tubular member; and

means for rotating the tubular support with the cutter blades supported thereon so that the tubular member is cut by the rotating cutter blades.

30. A system for radially expanding cutter blades for cutting a tubular member in a preexisting structure, comprising:

means for supporting the expandable tubular member using a tubular support member and an expandable cutter tool;  
means for injecting a fluidic material into the tubular support member; and  
means for actuating the expandable cutter tool radially outwardly relative to the tubular member and into cutting engagement with the tubular member using the injected fluidic material.

31. The system of claim 30, further comprising:

means for rotating the expandable cutter tool in cutting engagement with the tubular member when the expandable cutter tool is expanded radially outwardly relative to the tubular member.

32. The system of claim 31, further comprising:

means for continuing to rotate the expandable cutter tool in cutting engagement with the tubular member until an upper portion of the tubular member is severed from the tubular member;  
means for maintaining the expandable cutter tool in the radially expanded position after the upper portion of the tubular member is severed; and  
means for raising the expandable cutter tool with the severed tubular member portion supported thereon out of the preexisting structure.

33. The system of claim 30, wherein means for actuating the expandable cutter tool radially outwardly relative to the wellbore casing and into cutting engagement with the wellbore casing using the injected fluidic material, further comprises:

means for directing the fluidic material from within a portion of the tubular support member to an actuator cylinder to cause the cutting tool to slide axially on ramp surfaces so that cutting blades are moved radially outwardly.

34. The system of claim 30, wherein means for actuating the expandable cutter tool radially outwardly relative to the wellbore casing and into cutting engagement with the wellbore casing, wherein the tubular support member comprises:

an upper tubular support member and a lower tubular support member; and  
wherein actuating the expandable cutter tool comprises means for displacing the upper tubular support member relative to the lower tubular support member.

35. A cutter tool for a tubular member, comprising:

- a rotatable tubular support;
- a plurality of cutting elements supported on the rotatable tubular support, having a retracted position for insertion into the tubular member and having an expanded position for cutting engagement with the wellbore casing;
- a plurality of non-cutting elements supported on the rotatable tubular support, having a retracted position for insertion into the tubular member and having an expanded position;
- an actuator for moving the cutting and non-cutting elements from the retracted positions to the expanded positions;
- wherein the cutting elements are interleaved with the non-cutting elements; and
- wherein, in the retracted positions, the cutting elements and the non-cutting elements are positioned away from one another in an axial direction; and
- wherein in the expanded positions, the cutting elements and the non-cutting elements are brought together in the axial direction.

36. A method of cutting a tubular member, comprising:

- interleaving a plurality of cutting elements with a plurality of non-cutting elements;
- positioning the cutting elements and non-cutting elements within the tubular member;
- rotating and translating the cutting elements and the non-cutting elements until the cutting elements engage the tubular member; and
- rotating the cutting elements relative to the tubular member to cut the tubular member.

37. The method of claim 36, further comprising:

- rotating and translating the cutting elements and the non-cutting elements after cutting the tubular member.

38. The method of claim 36, wherein positioning the cutting elements and non-cutting elements within the tubular member comprises:

- spacing apart the cutting elements from the non-cutting elements in an axial direction.

39. The method of claim 36, wherein rotating and translating the cutting elements and the non-

cutting elements until the cutting elements engage the tubular member comprises:

moving the cutting elements towards the non-cutting elements in an axial direction; and  
displacing the cutting elements and the non-cutting elements outwardly in a radial direction.

40. A system for cutting a tubular member, comprising:

means for interleaving a plurality of cutting elements with a plurality of non-cutting elements;  
means for positioning the cutting elements and non-cutting elements within the tubular

member;

means for rotating and translating the cutting elements and the non-cutting elements until the  
cutting elements engage the tubular member; and

means for rotating the cutting elements relative to the tubular member to cut the tubular  
member.

41. The system of claim 40, further comprising:

means for rotating and translating the cutting elements and the non-cutting elements after  
cutting the tubular member.

42. The system of claim 40, wherein means for positioning the cutting elements and non-cutting  
elements within the tubular member comprises:

spacing apart the cutting elements from the non-cutting elements in an axial direction.

43. The system of claim 40, wherein means for rotating and translating the cutting elements and  
the non-cutting elements until the cutting elements engage the tubular member comprises:

means for moving the cutting elements towards the non-cutting elements in an axial direction;

and

means for displacing the cutting elements and the non-cutting elements outwardly in a radial direction.

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